Faculty Working Papers

PRICING OF LIQUIDITY FOR PREFERRED STOCKS ON THE NEW YORK STOCK EXCHANGE

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#662

College of Commerce and Business Administration
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THE EFFECT OF THE TIME HORIZON ON THE RELATIVE ABILITY OF DIFFERENT TIME-SERIES MODELS TO FORECAST QUARTERLY EARNINGS PER SHARE

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Summary

This study investigates the relative ability of several forecast methods proposed in the literature to predict quarterly EPS in terms of the length of the forecast horizon. It finds, contrary to previous notions of "search bias," that Box Jenkins models provide the most accurate forecasts for forecast horizons more than one year in the future. This phenomonon is empirically consistent with the hypothesis that the single models sometimes use incorrect differencing or omit a constant term from the model, and in those cases where the BJ differs on these factors, it provides the most accurate forecast.

The literature is replete with studies investigating the predictability and time series properties of quarterly earnings per share (EPS). This research has been motivated by many reasons including: 1) The Financial Accounting Standards Board (1977) has made expected future earnings a primary factor in their objectives framework. 2) The capital market/information content studies often rely on earnings expectation or prediction models and the use of inappropriate or misspecified models can result in erroneous inferences. 3) The Securities and Exchange Commission has been giving serious consideration to requiring listed firms to report earnings forecasts (1977). 4) Earnings forecasts are used in investment decision making. Nordby (1973) found that 99% of responding financial analysts used earnings forecasts in their decision making process.

Recent research has indicated that the time series properties of quarterly EPS can be usefully described by several models including those studied by Brown and Rozeff (1979), Foster (1977), and Griffen and Watts (1977, 1975). In addition some of these authors have applied the Box-Jenkins (1970) modeling process. (These models will henceforth be referred to as the BR, F, GW and BJ models respectively.) These models have been studied further by Lorek (1979) and Collins and Hopwood (1980) who investigated their relative ability to predict annual EPS from quarterly EPS. The findings indicate that the BR and GW models appear to provide the most accurate forecasts. The BJ forecasts are reasonably competitive but not more accurate; therefore, since the BJ modeling process is very time consuming, it thus far not proven its worth in this type of forecasting.

The previous research, however, has not included a systematic study of the relative accuracy of these models in terms of long run (greater from one year into the future) forecasting. The purpose of the present study is to make such an investigation. Specifically we investigate the possibility that the relative performance of these models changes as forecasts are made farther and farther into the future. The motivation for this research is that the forecast functions of these models converge to fixed lines as the forecast horizon is increased (Box and Jenkins (1970, Chapter 5; also see appendix 1) thus leaving the distinct possibility that as this convergence takes place, there is a shifting in the relative performance of the models.

Population Studied

Data pertaining to the sample of 267 calendar year New York Stock Exchange (NYSE) listed firms was obtained from the Compustat quarterly tape.[1] For a firm to be included in the sample, it was required to have no missing EPS data for the 64 consecutive quarters beginning with the first quarter of 1962. This provided a sample period from 1962 through 1977. The EPS number used was primary earnings per share excluding extraordinary items and discontinued operations, adjusted for capital changes.

Note that, unlike previous research, all firms which met the survivorship test were retained for analysis. We define this group to be the population of interest and make no attempt to generalize to a larger number of years or group of firms. To use statistical testing to make inferences about a larger group of firms would be unwarranted because there is no reason to believe that firms which fail to meet the

survivorship test are the same as those that do. In fact, a priori reasoning indicates that firms meeting the test are very likely to be larger and older than the average. Also attempting to generalize across all years would be unwarranted because structural changes in the economy might produce a shifting in the relative performance of different forecast methods. Even if this was not a problem, in order to generalize to all years, it would be necessary to obtain a reasonably large random sample of years. This is not possible because of limited data availability.

Since statistical testing is used for making inferences about a larger population and under the circumstances we felt that such inferences would be unwarranted, no statistical tests are presented in this paper. Instead, our goal is to present results for an entire population which is of interest in its own right.

Model Estimation

All of the foregoing models were estimated for all of the sample firms. The years of 1974 through 1977 were used as hold-out periods and were used in studying forecast accuracy. Therefore, the 267 firms were each modeled 16 times, once for each method using pre-1974 data (48 quarters in the base period) and again for each method (49 quarters in the base period) using all data prior to the second quarter of 1974, etc. (The BJ models were reidentified each quarter.) The result was that each model made predictions for 16 quarters into the future (thus providing a forecast horizon from 1 to 16 quarters) for each of the 16 base periods in the hold-out period. For each period in the

forecast horizon and each method the mean absolute percentage forecast error was computed.[2]

Empirical Findings

Figure 1 presents the forecast error profiles for the BR, F and GW models (we shall henceforth refer to these three models as Premier models since in each case a single or premier model is used for all firms). All three profiles are relative to the BJ model and in each case the forecast error is equal to the error for the given model minus the BJ error. Therefore the area below the dotted zero line indicates that the given model error is smaller than the BJ error. Note that within the first four quarters on the horizon the BR forecasts are more accurate than those of BJ three out of four times. This superior performance is consistent with the above cited research which indicates that the expensive BJ modeling process is not warranted. Note, however, that beyond four quarters all three models dramatically deteriorate relative to the BJ. The upward sloping lines indicate that the longer the forecast horizon the greater the deterioration. This phenomonon is particularly interesting since previous research has made unconditional inferences in terms on one model versus another. These results clearly show that beyond four quarters in the future the BJ provides the most accurate forecasts.

[Figure 1 about here]

An Explanation of the Finding

In order to explain the finding we first consider some background on the BR, F and GW models relative to the BJ type model. The distinguishing factor of the BJ model is that the BJ modeling process selects

a model for each firm whereas the BR, F and CW models are single (or "premier") models used for all firms. A decade or so ago, when the BJ modeling process was first being applied in this area, it was thought that using a separate model for each firm would provide the most accurate forecasts. This is because the BJ process explicitly models all nonrandomness in the data and the premier models often result in highly correlated residual errors. Later Foster (1977) proposed that selecting a separate model for each firm might result in a problem he termed "search bias." This means that in searching for a model for each firm one will often select an inappropriate model because of variation in individual firm EPS. As mentioned above, subsequent research supported this hypothesis, and BJ model forecasts were found not to be more accurate than those of the single models.

This raises the question: why then should the BJ models perform better as the forecast horizon increases? Our hypothesis is that while the BJ process is subject to search bias it does a better job of determining the need for differencing and having a constant term in the model. We consider these factors important because, as discussed in appendix 1, they determine the shape of the forecast function as it converges. Under this hypothesis we would expect the premier models to be at their worst (relative to the BJ) when they disagree with the BJ with respect to the type of differencing and presence of a constant term in the model. Henceforth we shall say that the premier model has the same profile as the BJ when it has the same type of differencing and agrees with the BJ with respect to the need for a constant in the model.

Figures 2, 3 and 4 present evidence on this hypothesis for the BR, F and GW models. In each case the firms are partitioned into 3 groups: 1) all firms. This is the same as Figure 1. 2) Those firms where the given premier model has the same profile as the BJ model. In these cases our hypothesis predicts that the single should be at its best relative to the BJ. 3) Those firms where the given premier model has a profile which differs with that of the BJ. In these cases we would expect the single model to be at its worst.

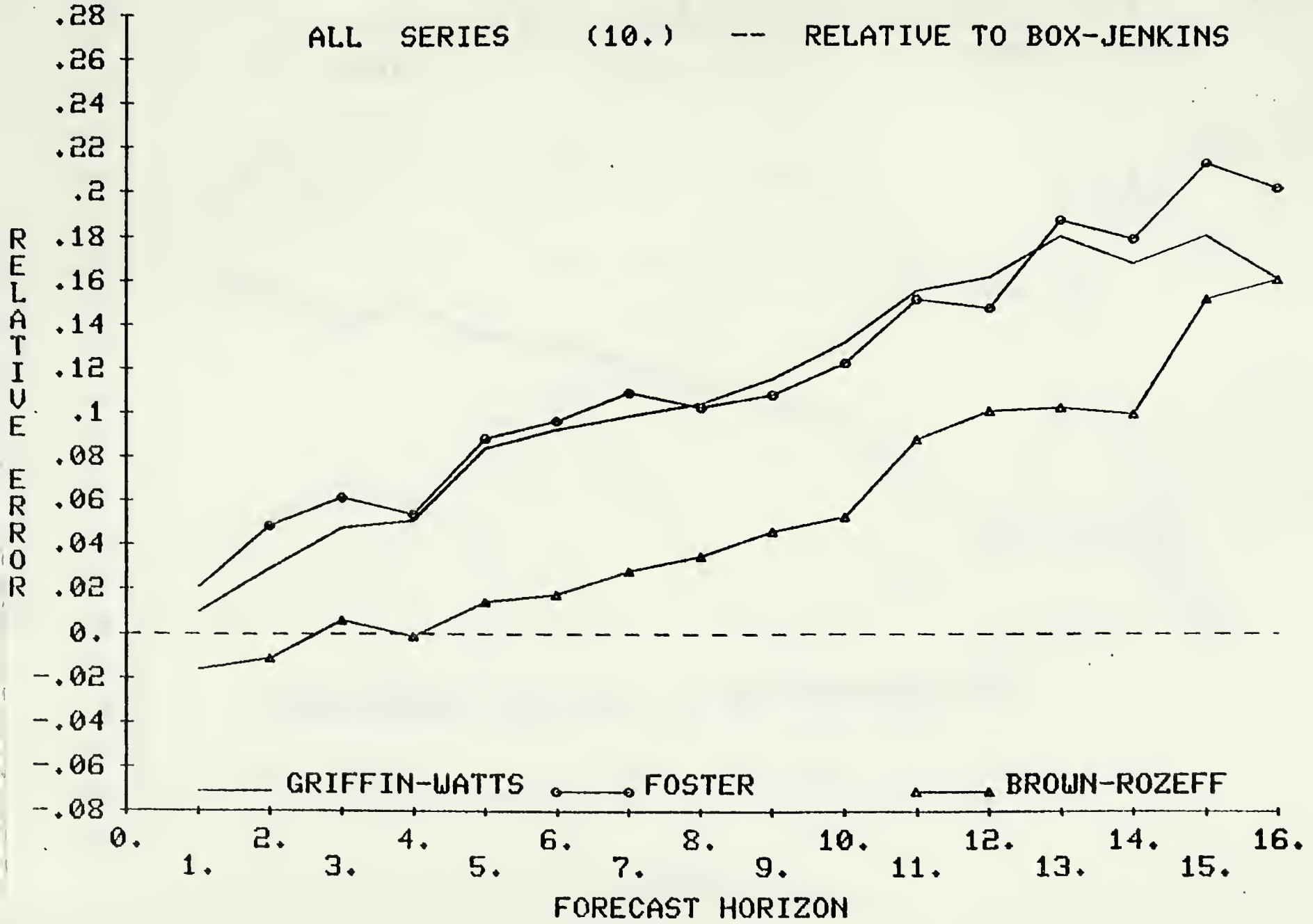
[Figures 2, 3 and 4 about here]

Again these figures show the mean absolute percentage error of the premier model minus the same error for the BJ. This means that the lower the line the more accurate the forecasts are, and a line below the zero line (dotted line) indicates that the premier outperforms the BJ. Note that for all three premier models the hypothesis is confirmed. In fact the BR and GW models actually outperform the BJ models which have the same profile. The Foster model also strongly indicates results in the direction predicted by the hypothesis.

Summary and Conclusions

This study investigated the relative ability of several forecast methods proposed in the literature to predict quarterly EPS in terms of the length of the forecast horizon. It found, contrary to previous notions of "search bias," that BoxJenkins models provide the most accurate forecasts for forecast horizons more than one year in the future. This phenomonon was empirically consistent with the hypothesis that the single models sometimes use incorrect differencing or omit a constant term from the model, and in those cases where the BJ differs on these factors, it provides the most accurate forecast.

Figure 1


ALL SERIES (10.) -- RELATIVE TO BOX-JENKINS
RELATIVE ERROR
.28
.26
.24
.22
.2
.18
.16
.14
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.1
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0.
-.02
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GRIFFIN-WATTS
FOSTER
BROWN-ROZEFF
0.
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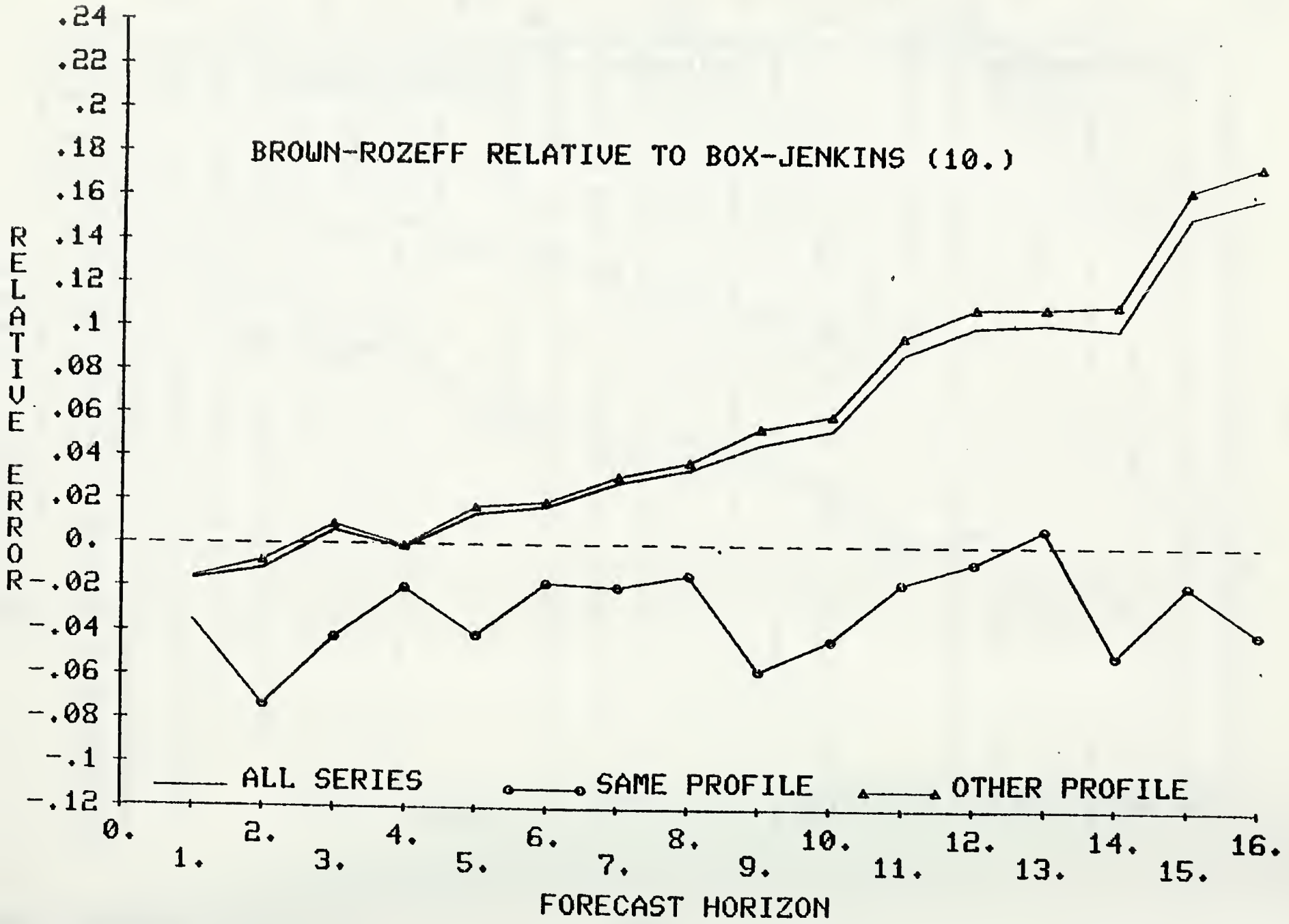
FORECAST HORIZON

Figure 2


BROWN-ROZEFF RELATIVE TO BOX-JENKINS (10.)
RELATIVE ERROR
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.18
.16
.14
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.04
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-.02
-.04
-.06
-.08
-.1
-.12
ALL SERIES
SAME PROFILE
OTHER PROFILE
0.
1.
2.
3.
4.
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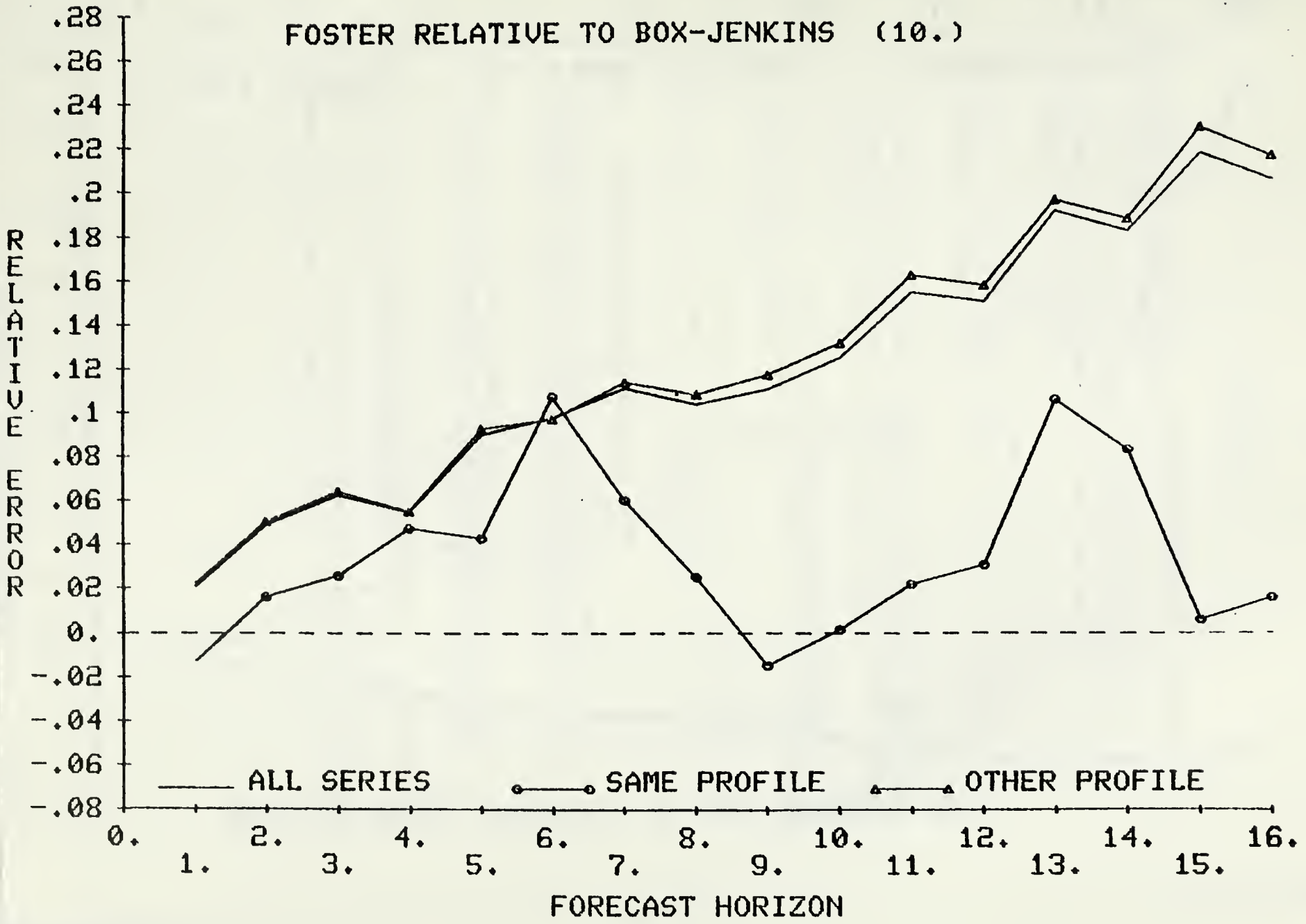
FORECAST HORIZON

Figure 3


FOSTER RELATIVE TO BOX-JENKINS (10.)
RELATIVE ERROR
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ALL SERIES
SAME PROFILE
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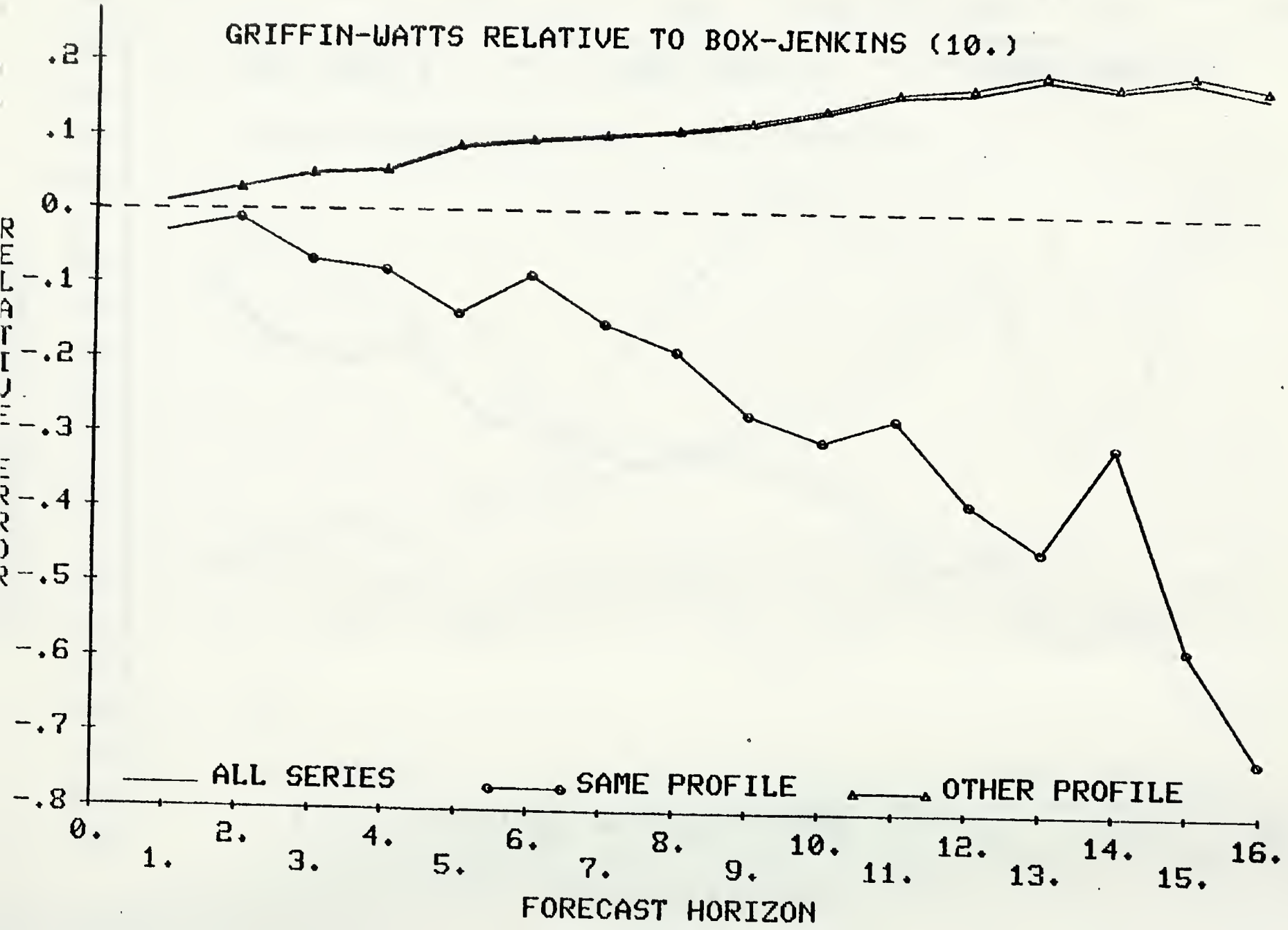
FORECAST HORIZON

Figure 4


GRIFFIN-WATTS RELATIVE TO BOX-JENKINS (10.)
.2
.1
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-.1
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-.3
-.4
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ALL SERIES
SAME PROFILE
OTHER PROFILE
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FORECAST HORIZON

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Notes

[1]We required the firms to be listed during the entire sample period. The Center for Security Price Research (CRSP) monthly tape was used to select NYSE listed firms. A firm was considered listed if it had monthly stock returns available for the entire sample period.

[2]The absolute percentage error is computed as the average of $\left|\frac{\text{Actual EPS - Predicted EPS}}{\text{Actual EPS}}\right|$. Since this error metric can be explosive when the denominator approaches zero we truncated errors in excess of ten to a value of ten. This operation was done for a very small percentage of the cases.